

REMARKS

Applicants and their representatives would like to thank the Examiner for the helpful and courteous telephonic interview of February 13, 2003. In view of our discussion we have amended the claims to address the Examiner's concerns.

§ 102 Rejections

Independent Claims 1, 10, and 26

The Examiner rejected independent claims 1, 10, and 26 as anticipated by Spuhler (Electronics Letters, 1 April 1999). Each of claims 1 and 26 requires a semiconductor element positioned within the cavity to provide increasing absorption of radiation at the operative wavelength as energy density of radiation at a surface of the semiconductor element increases. Claim 10 requires one or more layers of a second semiconductor material positioned within the cavity to provide increasing absorption of radiation at the operative wavelength as energy density of radiation at a surface of the second semiconductor material increases. For example, in one embodiment described in the applicants' specification, the semiconductor element is a thick layer of InP positioned within the cavity to produce sufficient TPA at the operative wavelength such that it provides increasing absorption of radiation at the operative wavelength as energy density of radiation at a surface of the semiconductor element increases. The Spuhler article does not disclose these elements of claims 1, 10, and 26.

Spuhler simply describes a "passively mode-locked diodepumped bulk $\text{Er}^{3+}:\text{Y}^{3+}$:glass laser." (Spuhler, p. 569.) Spuhler's reflector includes an AlAs/GaAs backmirror with four InGaAs quantum wells grown on top of the backmirror for saturable absorption. Spuhler's mirror does not include a "semiconductor element positioned within the cavity to provide increasing absorption of radiation at the operative wavelength as energy density of radiation at a surface of the semiconductor element increases," such as an InP layer, as required by claims 1 and 26.

In the office action, the Examiner labels the final GaAs layer of Spuhler's backmirror as a "semiconductor element 30," and contends that this GaAs layer produces nonlinear increasing loss. According to the Examiner:

It is not explicitly disclosed that the semiconductor element of these claims [sic, of Spuhler] produces nonlinear increasing loss, but when the structure recited in the prior art is substantially identical to that shown in the claims, claimed properties or functions are presumed to be inherent. As the structures are the same, it is presumed that the semiconductor element will produce nonlinear loss.

(Office Action, p. 3.) The Examiner is mistaken about the structure in Spuhler—Spuhler's structure is not "the same" as or "substantially identical to" the applicants' claimed structure. Comparing Spuhler's structure to, e.g., applicants' embodiment shown in Figs. 4A-4C, both reflectors include an AlAs/GaAs backmirror and InGaAs quantum wells for mode-locking. However, Spuhler's structure entirely lacks a semiconductor element positioned within the cavity to provide increasing absorption of radiation at the operative wavelength as energy density of radiation at a surface of the semiconductor element increases, such as the thick InP layer of the applicants' embodiment.

While the GaAs layer in Spuhler's backmirror may produce some small amount of incidental TPA, nothing in Spuhler suggests it will provide increasing absorption of radiation at the operative wavelength as energy density of radiation at its surface increases. By way of example only, one of the benefits of the claimed semiconductor element is enhanced stability of the mode-locked output. Like the prior art "conventional" systems referenced in applicant's specification, Spuhler's structure will have a stability profile similar to curve 56 in Fig. 7,¹ rather than an enhanced stability profile such as, e.g., curve 58. Spuhler's laser, therefore, like other prior art conventional systems, must be operated at higher power to avoid instability.

For at least the reasons discussed above, Spuhler does not disclose or suggest "a semiconductor element positioned within the cavity to provide increasing absorption of radiation at the operative wavelength as energy density of radiation at a surface of the semiconductor element increases" (claims 1 and 26); or "one or more layers of a second semiconductor material

¹ There is insufficient data in the Spuhler article to determine the precise contours of the stability profile of Spuhler's reflector. However, since Spuhler lacks the TPA producing InP layer of applicants' described embodiment, there is no reason to believe Spuhler's stability profile will be substantially different than curve 56 of Fig. 7.

positioned within the cavity to provide increasing absorption of radiation at the operative wavelength as energy density of radiation at a surface of the second semiconductor material increases" (claim 10). These claims, therefore, are patentable over Spuhler.

Claims 2-9 depend from claim 1 and are patentable for at least the same reason that claim 1 is patentable. Claims 11-19 depend from claim 10 and are patentable for at least the same reason that claim 10 is patentable. Claims 27-31 depend from claim 26 and are patentable for at least the same reason that claim 26 is patentable.

§ 103 Rejections

Independent Claims 20 and 32

The Examiner rejected independent claims 20 and 32 as obvious over Spuhler in view of Shen (U.S. 5,764,679). Claims 20 and 32 are directed to an actively mode-locked laser system. Claims 20 and 32, like claims 1, 10 and 26, recite inclusion of a semiconductor element or material positioned within the cavity to provide increasing absorption of radiation at the operative wavelength as energy density of radiation at a surface of the semiconductor element or material increases.

According to the Examiner, Spuhler satisfies all elements of the claims except for active mode-locking. Applicants disagree. As discussed above, Spuhler does not disclose "a structure disposed along an optical path in the cavity, the structure comprising a semiconductor material positioned within the cavity to provide increasing absorption of radiation at the operative wavelength as energy density of radiation at a surface of the semiconductor material increases," (claim 20), and nowhere describes or suggests "incorporating a semiconductor element into the cavity, the semiconductor element positioned within the cavity to provide increasing absorption of radiation at the operative wavelength as energy density of radiation at a surface of the semiconductor element increases, to limit peak intensity of the pulses, and thereby suppress supermodes" (claim 32).

Claims 21-25 depend from claim 20 and are patentable for at least the same reason that claim 20 is patentable. Claims 33-35 depend from claim 32 and are patentable for at least the same reason that claim 32 is patentable.